MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2022/2023 (TERM ID 2210)

EEN1016 –ELECTRONICS I

(TE / RE)

11 FEBRUARY 2023
9.00 a.m. - 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 4 pages excluding the cover page with 4 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

QUESTION 1

(a) Determine the electron configurations of C (atomic number = 6), Al (atomic number = 13) and Ni (atomic number = 28).

[6 marks]

(b) Can an electron with $n = 1$, $\ell = 0$, $m_l = 0$, and $m_s = +1/2$ exist in the same atom as a second electron with $n = 2$, $\ell = 0$, $m_l = 0$, and $m_s = +1/2$? Justify your answer with Pauli Exclusion Principle.

[5 marks]

(c) At T=300K, the electron concentration in silicon is $8x10^9$ cm^{-3}. Given that the intrinsic carrier concentration is $2.5x10^{13}cm^{-3}$. Find the hole concentration and justify whether this material is n-type or p-type.

[4 marks]

(d) Illustrate on how a DC battery is connected to a PN junction to make it forward bias and reverse bias by indicating the polarities of the battery. Explain the width difference of depletion region during forward bias and reverse bias modes.

[10 marks]

QUESTION 2

(a) Figure Q2a shows a positive clipping circuit.

(i) Modify the circuit by changing it to negative clipping circuit without adding new component(s) or removing existing component(s).

(ii) Based on the circuit from part 2(a)(i), draw the output voltage waveform for 2 complete cycles if given $V_i = 10 \sin \omega t$ and $V_b = 6V$. Assume that threshold cut in voltage, V_γ is 0.6V for non-ideal.

(iii) Draw the output voltage waveform for 2 complete cycles if V_b is reversed.

[2+4+4 marks]

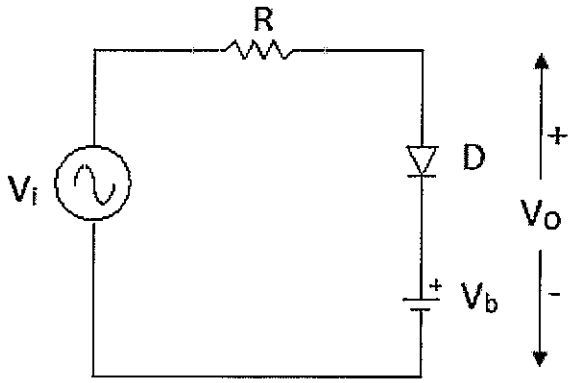

Figure Q2a

(b) Refer to Figure Q2b, the output of the circuit is used to charge a 24V DC battery at average current of 2A. Assume all diodes are ideal.

(i) Determine the required peak inverse voltage, PIV for the diodes.
(ii) Find the average output voltage of the circuit.
(iii) A resistor is used to limit the output current to 2A. Illustrate the placement of the resistor in the circuit and calculate the value of the resistor.

[3+2+5 marks]

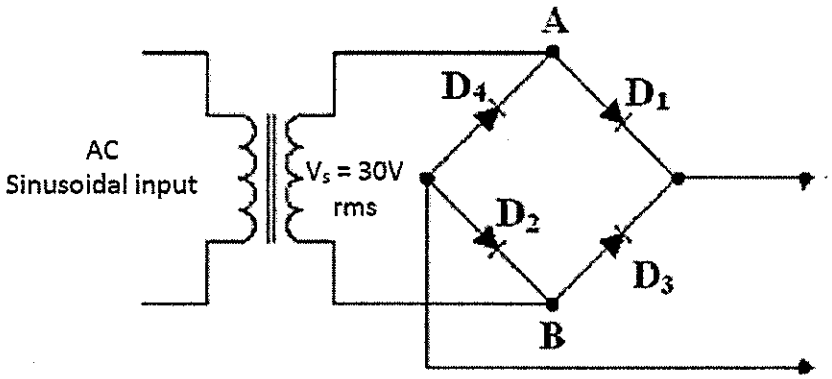

Figure Q2b

(c) Draw a basic clamping circuit and shows how its output voltage changes with the sinusoidal input voltage. List down TWO features of a typical clamping circuit.

[5 marks]

QUESTION 3

The transistor circuit ~~as shown~~ in Figure Q3 is to be operated with $\beta = 80$, $V_{BB} = 4V$, $R_B = 220k\Omega$, $R_C = 2k\Omega$, $V_{CC} = 10V$ and $V_{BE(on)} = 0.7V$.

(a) Determine the Q-point.

[8 marks]

(b) Calculate the power dissipation of the transistor.

[5 marks]

(c) Given that the transistor has a dissipation constant (P_D) of $4mW/^oC$, find the change in I_C if every increase of $1°C$ would cause the $V_{BE(on)}$ to drop by 0.05V.

[6 marks]

(d) List out THREE parameters that could affect the bias stabilization of a transistor. Define the stability factor of each parameter.

[6 marks]

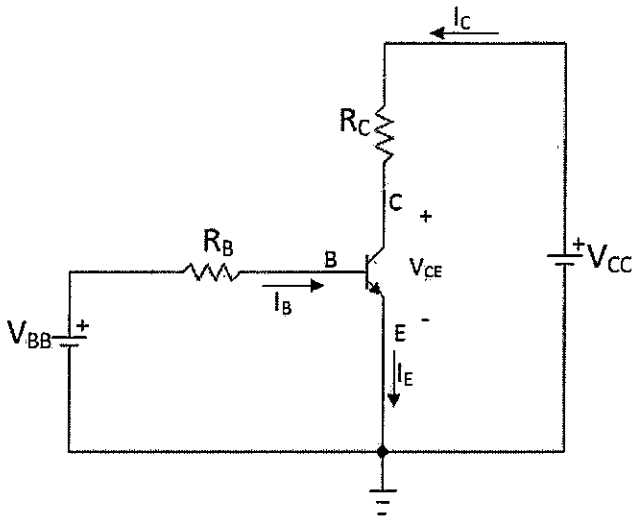

Figure Q3

QUESTION 4

A transistor amplifier circuit is shown in Figure Q4. Given the transistor parameters in Table Q4:

a) Draw the small signal hybrid model equivalent circuit. [4 marks]

b) Determine the current gain, $A_{IS} = \frac{I_o}{I_S}$. [10 marks]

b) Determine the voltage gain, $A_{VS} = \frac{V_o}{V_S}$. [8 marks]

c) Find the input impedance, R_i . [3 marks]

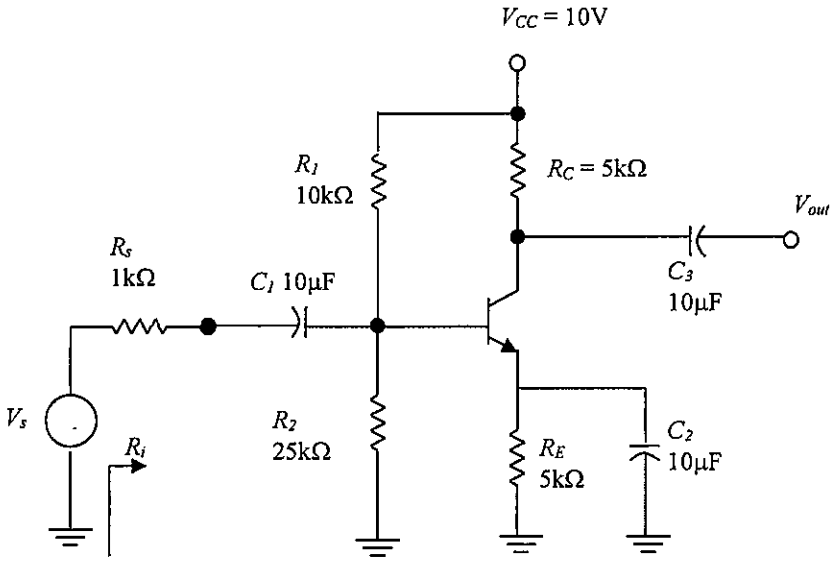

Figure Q4

Table Q4. Transistor parameters

parameters	CC	CE	CB
h_i	1100 Ω	1100 Ω	21.6 Ω
h_r	1	2.5×10^{-4}	2.9×10^{-4}
h_f	-51	50	-0.98
h_o	25 μA/V	24 μA/V	0.49 μA/V

End of Page